TRENDS OF WIND SPEED IN LOW TROPOSPHERE FROM GLOBAL RADIOSONDE DATA

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Introduction

The knowledge about long-term changes in wind speed (S) distribution in the low troposphere is necessary for studies of global climate change, geo-economic justification of nuclear power stations construction, needs of aviation, shipping and other science and practical needs. The paper presents the trends in the time series of wind speed in the low tropospheric layer from the surface to the 2-km height over the Globe for different months, seasons, and a year. In addition, the estimates of the trend long-term changes are presented in dependence of the trend computing period.

Data and methods

The computations are based on the radiosonde data of 683 stations from the global aerological network. Data from aerological dataset CARDS [1] supplemented by current data from datasets AROCTAB [2] and AROCTAC [3] for the observational period of 1964—2018 were used for this research. The data were subject to a complex quality control procedure.

The Akima cubic spline interpolation method was used for calculating S in the tropospheric layer 0—2 km over the surface level with taking into account specific points of the vertical profiles. The necessary condition for including a station from the global aerological network to research for the full period of 1964—2018 was the presence of observations for 1990—2010. The trends for every station were estimated using the least squares method. The anomalies were calculated with respect to the corresponding long-term mean values S for the full period of 1964—2018. The trend long-term changes were estimated using the corresponding time series of the trends calculated by reducing periods with approaching to the end of 2018. The values obtained for each station were averaged for the Globe taking into account the square of the station influencing area.

Results

Figs. (a—c) show that the spatiotemporal distributions of the long-term means S, their trends, and the tendency of the trend changes are not uniform in the layer 0—2 km above the surface. The range of inter-annual changes of the linear trends of anomalies of the long-term monthly means S in the 0—2-km low tropospheric layer is of -0,075—0,274 m/s *decade^{-1} (Fig. b). The wind speed in this layer over the Globe increases mainly at 0,4—0,7 km above the surface. We can see negative trends near the surface.

The tendency of the trends increase (Fig. c) is detected mainly at 1—2 km above the surface from November to July and also at the heights of 0,1—0,4 km — from May to July. The trend long-term changes vary from 0,020 to 0,113 m/s *decade^{-2} for different months.

Conclusions

The spatiotemporal distributions of the trends and the linear trends of the wind speed trends are not uniform in the tropospheric layer 0—2 km over the Globe. The wind speed increases mainly at the heights of 0,4—0,7 km. The tendency of the trends increasing can be seen at the heights of 1—2 km for most of the year.

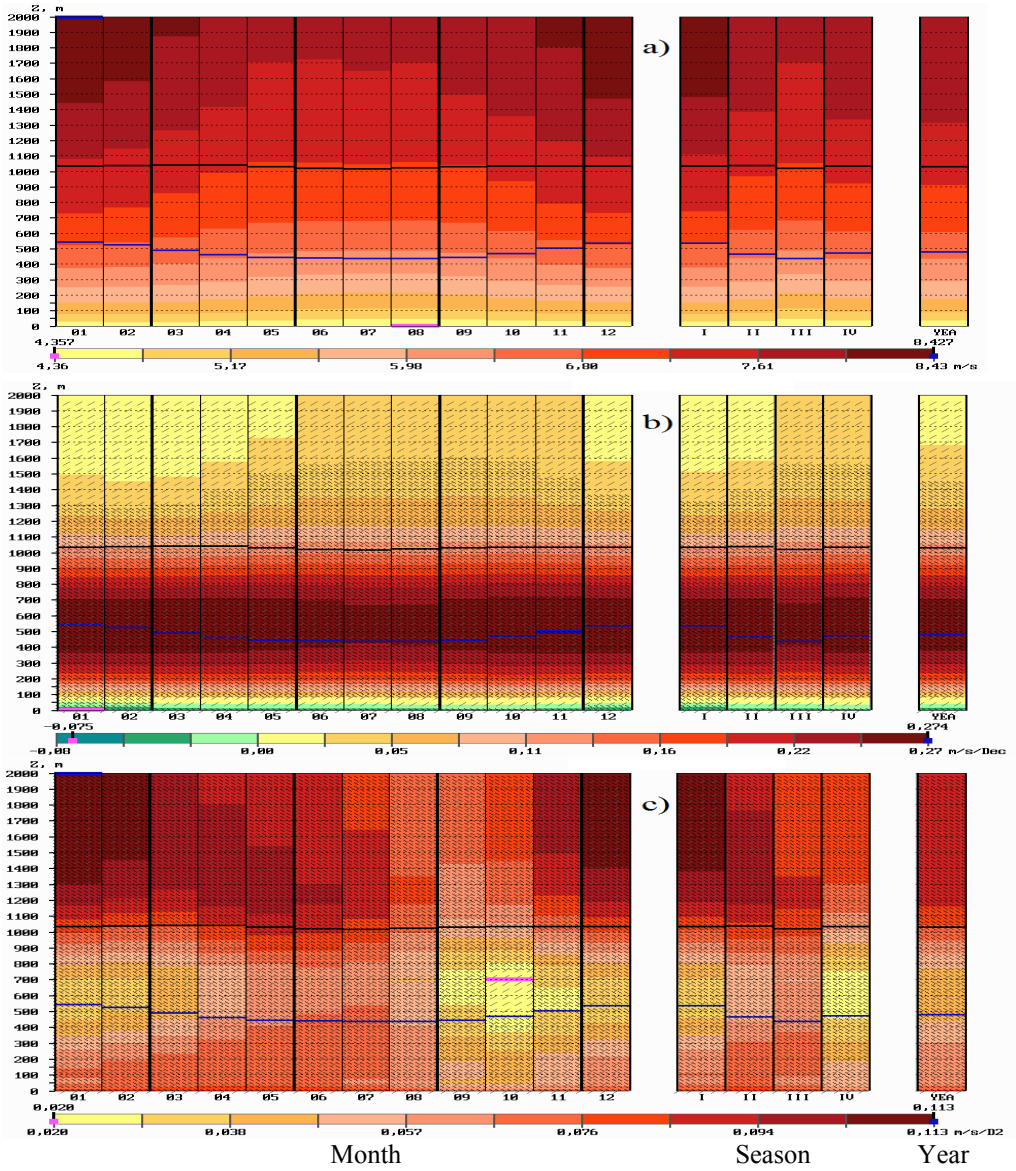

Fig. Long-term mean values (a) for wind speed, m/s; the linear trends of anomalies of long-term means (b) for wind speed, m/s *decade^{-1}; the linear trends of the wind speed trends (c), m/s *decade^{-2}, in the low tropospheric layer 0—2 km for every month, season (I, II, III, IV for DJF, MAM, JJA, SON correspondingly), and for a year. The global statistics for months and seasons were subject to a twofold smoothing. The three–points smoothing was used. Trends with significance not less than 50% are marked by sloping line segments and with significance not less than 95% — by lattice. Blue and pink segments correspond to maximum and minimum values. Black and blue lines correspond to heights of mixing level and surface inversion in 1964—2018.

References

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